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THE INTRODUCTION AND SPREAD OF PIERIS RAPAE
IN NORTH AMERICA, 1860-1886.

By SAMUEL H. SCUDDER.

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III. THE INTRODUCTION AND SPREAD OF *PIERIS RAPAE* IN NORTH AMERICA,
1860-1886. WITH A MAP (PLATE 8).

BY SAMUEL H. SCUDDER.

(Read May 4, 1887.)

IT is well known that the different races of men have not always occupied the regions which they now inhabit, but that from the earliest times one wave of migration has followed another, in a manner that has proved very perplexing to the ethnologist attempting to follow them. That the lower animals also have had their migrations has been frequently proved by the occurrence of their remains in regions where they are not now found. Secular change of climate has been the great moving cause of most of the migrations of which we have any knowledge, with the single exception of the influence of man, and particularly of civilized man; he is everywhere upsetting the arrangements of nature, directly or indirectly exterminating all forms which cannot endure his presence or withstand the baleful influences which follow in his train. To minister to his wants, for instance, he brings into a new region a plant foreign to its soil that he may have the fruit ready to his hand. Without the natural hindrances which prevent its supremacy in its native home, it thrives so vigorously, if otherwise adapted to the place, as to supplant the natural denizens of the soil; these are supporting numerous animals, which in their turn suffer.

So it has doubtless been in all ages of the world, where by any of the multifarious means which nature employs she has herself upset the balance she had established, by bringing into a flora or a fauna some new element from without. Indeed, the history of animal and plant life has been a story of colonization. Any one who has observed the rapidity with which weeds spread over new countries, has read of the rabbit nuisance in Australia or seen the sparrow nuisance in America, will comprehend what a force colonization may have been. It was closely linked no doubt with the introduction of new types in past ages of the world.

The measurement of the spread of a newly introduced species has rarely been attempted. Indeed, in the nature of things it could scarcely ever be made except under circumstances which may fairly be deemed artificial, *i. e.*, in countries tolerably well settled with people intelligent enough to report accurately. Rarely, too, is the date of

introduction known. Yet as this could be approximately determined for the European cabbage butterfly recently imported into this country, and as by its ravages of a common garden crop it would make itself known by the damage it did and so force itself upon observation, it seemed a favorable opportunity to consider this question, which should not be missed; it was believed indeed that the correct measure of its spread might have some import for future investigation, and perhaps its lesson for him who would designedly introduce a new creature without regard to its relations to other animals.

As the insect has already crossed half the continent, the time has certainly arrived to make the necessary inquiries. Every one now knows that it has come to stay and little attention is given to its movements. Most of those who observed it on its first advent can still answer questions regarding its appearance by the aid of notes taken at the time, which later might not be possible. Accordingly, last autumn, I issued a circular to over six hundred persons in different parts of the country with the inquiry: "In what year, to your personal knowledge, did *Pieris rapae* first appear in your vicinity?" and asking also for any published data upon the matter. To this inquiry more than two hundred replies were received and from them, from the notes I had previously made based on special written inquiries in 1869 and 1870, and from various publications, the following account is drawn up.

The butterfly was first noticed in Canada and the actual history of our knowledge of its first appearance there is as follows:— Mr. Wm. Couper, a taxidermist and general collector, addicted especially to Lepidoptera and a good observer, living in Quebec, first captured a few specimens in 1860 in the immediate vicinity of that city; he then looked upon the insect as a great rarity, and indigenous to Canada. In 1863 a new collector appeared in Quebec, Mr. G. J. Bowles, who, capturing it and finding no such insect described in American works, applied to Mr. Couper, only to discover him equally at a loss. Mr. Bowles then wrote to Mr. Wm. Saunders of London, Ontario, and to myself, and we both assured him that it was the European insect. Mr. Bowles' letter to me bore date Dec. 23, 1863.¹ In April and July 1864, these gentlemen read papers before local societies, both of which were published in whole or in part;² from these we learn that in 1863 the butterfly was very common and destructive in the neighborhood of Quebec and at Laval fifteen miles north, and had extended thirty miles to the northwest along the north shore of the St. Lawrence, though they had not been noticed beyond Point Levis on the south, nor taken at St. Anne's on the south shore of the St. Lawrence, seventy miles down the river, "where a collector of Lepidoptera resided." From what we know of the rapidity with which a single pair may propagate without hindrance from parasites, we may conclude almost with certainty that it was introduced in the early part of 1860, or at the earliest, at the very close of 1859. Owing, apparently, to Mr. Bowles' paper published in the Canadian Naturalist in 1864, in which he fixes the period of its introduction to Quebec "at about seven or eight years ago," it has been generally spoken of as introduced "in 1856 or 1857." But Mr. Bowles has allowed more time than is necessary, and records do not go back of 1860.

¹ Specimens were also sent to W. H. Edwards in Dec. 1862, but seem not to have been noticed by him.

² For Mr. Bowles' paper see Bibliography. Mr. Couper's appears to have been published only by extract in 1867 by Mr. Ritchie, *Can. Nat. n. s.* 3: 29.

Following the report of Mr. Couper of its distribution in 1863, we have at first but scanty information concerning its spread in Canada. Capt. Gamble Geddes of Toronto states that he first took it "about 1864, about ninety miles below Quebec; when I brought it back and showed it to Professor Fowler, then connected with the Natural history society of Montreal, he assured me it was quite the first that had been taken." This fixes the date of capture as before the publication (in Montreal) of Mr. Bowles' paper and indicates that in 1864, the insect had spread to Murray Bay, ninety miles below Quebec on the north shore of the St. Lawrence. 1864.

In 1866 begins our first considerable knowledge of the spread of the butterfly, as it has reached more populous districts. Mr. Wm. Saunders, on an excursion to the Saguenay (Can. Ent. 1, 11), found it at Cacouna opposite and a little above the mouth of the river and at Ha Ha Bay at the head of steamboat navigation on the Saguenay, as well as all the way to Chicoutimi, twelve miles further up the river; it was not, however, found at Tadousac at the mouth of the Saguenay. We know by its subsequent record that it must have spread westward and especially southward by 1866, and it was indeed taken at Brome township within a dozen miles of the Vermont border by the Rev. T. W. Fyles. Dr. G. Dimmock, writing later in the N. E. Homestead (Vol. III, No. 46, Mar. 25, 1871), speaks of it as found this year also in northern New Hampshire and Vermont, but without specification, and Dr. J. C. Merrill reports the capture of a single specimen in the White Mountains (Proc. Bost. Soc. Nat. Hist., 11, 300); that it must have invaded these two states this year is certain from the considerable numbers found the year following. I have accordingly drawn the curve of its distribution to include this northern area. Moreover it is certain that it had reached this latitude in Maine, for there is a specimen in the Yale College Museum, No. 1,745, which was taken by Prof. S. I. Smith in Norway, Maine, in 1865, the earliest record of its capture in the United States. Probably it had covered the larger part of Maine wherever in the wilderness it could find a patch under cultivation for, writing from Garland in Penobscot Co., under date of Aug. 23, 1869, to the N. E. Farmer (N. S. III, 506), Mr. H. C. Preble says that he has "not been able to raise a respectable cabbage for some four or five years, on account of the ravages of this species of voracious rascals." Even if we credit him with some exaggeration from discouragement, we can hardly think the insect arrived there later than 1866, the more probably as Professor Smith again helps us by preserving in the Yale Museum two specimens captured by him at Eastport, on July 4, 1866. 1866.

The following year, 1867, marks a better known advance, for in May it reached Montreal, according to Mr. Ritchie (Can. Nat. III, 295) to the southwest, and extended on the southeast even to Halifax, Nova Scotia, as Mr. J. M. Jones testifies in a paper (Proc. N. S. Inst. III, 20) read three years later, a publication which has been entirely overlooked, its introduction to this point being heretofore placed as in 1871, since Mr. Jones later spoke of it as very abundant in the spring of that year (Can. Ent. III, 37). In Maine it was observed at Lewiston far toward the southern extremity of the state, though resident entomologists elsewhere in the state did not discover it until the following year. The late Mr. P. S. Sprague of Boston was one of those who found it at Lewiston (Proc. Bost. Soc. Nat. Hist., XI, 300) and Mr. W. Dickinson of Worcester, the other; the latter found it both this year and the next, but only in 1868 very destructive. 1867.

Notwithstanding the number of entomologists who annually visit the White Mountains, and the recorded capture by Mr. Merrill in 1866, *supra*, no one seems to have taken the insect in New Hampshire in 1867; though with its spread to Lewiston on one side and its appearance in considerable numbers in Vermont on the other, there can be little doubt that it was present, at least in the region north of the White Mountains and especially in the valley of the upper Connecticut. In Vermont, Dr. Merrill is our only authority (Proc. Bost. Soc. Nat. Hist. xi, 300). In August of this year he found the butterflies at Waterbury, Burlington and Stowe; in the first locality, on Aug. 29, they were "very abundant." During this year, therefore, the insect had fairly established itself in northern Vermont and New Hampshire, reached Montreal in its course up the St. Lawrence and pushed its advance guard to the Atlantic Ocean at Halifax and nearly to the Gulf of Maine at Portland.

In 1868, curious to say, our records are more meagre but in one respect very interesting. It was only in this year and toward the end of it that it reached Waterville, Me., to judge from the fact that it was first seen in the early spring of 1869 by a very careful resident observer, the late Prof. C. E. Hamlin. The butterflies must have
1868. come from wintering chrysalids near by. In New Hampshire and Vermont its progress was steady but not extensive. In New Hampshire it was taken this year by Mr. M. C. Harriman at Warner near the Southern Kearsarge, and was seen, according to Dr. C. S. Minot (Am. Ent. ii, 75), near Lake Winnepesaukee. In Vermont it had extended to about the same points, for it was common at Woodstock (F. R. Jewett) and not uncommon in August in Sudbury (S. H. Scudder), while in all the track behind it was abundant enough. Writing to me from St. Albans in 1869, Mr. N. C. Greene said that in the previous autumn his 3000 cabbages had from ten to fifty worms on a head; he had not previously noticed them at all and thought they first came in 1868, whereas they must have reached St. Albans early the year before that. In the valley of the St. Lawrence there is nothing, for a time, to gauge its movements, but writing in Sept., 1869, Mr. A. S. Ritchie says that he has heard of its ravages as far west as Chateauguay, so that it doubtless was to be found there in 1868. Nor can we say more concerning its extension into the eastern provinces, though I am told by Mr. G. F. Matthew that it appeared at St. John "within two or three years of its recorded advent at Quebec" and, therefore, certainly not later than 1868. Indeed we have seen that it was just on the border, at Eastport, in 1866, and Prof. L. W. Bailey, writing in 1886, says it has been at Fredericton "for at least twenty-five years," but he speaks only from recollection.

But the chief interest of the year 1868 lies in the fact that it was then independently introduced into the country at New York. Rumor has it that a German entomologist in Hoboken received some living pupae from Europe to raise for his cabinet, that they emerged from the chrysalis in his absence and afterward escaped from an opened window. But *however* this may be, we know from several sources that it was to be found about Hoboken and Hudson City, N. J., this year. Mr. John Hampson, a collector of twenty-six years' experience, living in Newark, took a single specimen there this year in May (J. B. Angelman). The late Mr. W. V. Andrews, sending me caterpillars in July, 1869, said it had "been known for a year or two," and the same writer says (Can. Ent. ii, 55) in Jan., 1870, "the increase of this insect *during the last two years* is marvellous."

Indeed its abundance the next year at Bergen Hill, West Hoboken and Hudson City is proof that the first specimens came to the spot in 1868. The fact that New York City does not draw upon the Lake Champlain region for its cabbages (as I am informed by Mr. Lintner of Albany) and the subsequent evident spread of *Pieris rapae* from two points prove this to have been in all probability an independent introduction into the country. It is only surprising that it was so long delayed.

The spread of the butterfly from this new centre during 1869 does not appear to have been very great. That in scanty numbers it followed the track of the railway toward Philadelphia is probable from the nature of things and from the fact that Mr. J. P. R. Carney took a specimen that year within the present limits of Camden, 1869. which he at the time supposed came across the ocean in a vessel, then unloading near by; yet Mr. Andrews wrote, under date of Aug. 26th in that year, that while "quite abundant in the neighborhood of Bergen Hill and Hudson City, ten miles hence I could not find a single specimen." It reached West Farms in the autumn of that year, where it was seen by Mr. James Angus, but not taken; specimens were however taken the following April fresh from the pupa. It was also reported as very common in 1869, in the parks and gardens of New York city, by several observers, though Mr. T. L. Mead, an enthusiastic lepidopterist at the time and a resident of the city, records the capture of a single specimen on the Jersey side of the Hudson River (Can. Ent. II, 36) as if its presence in the metropolis were quite unknown to him. It seems probable therefore that its occurrence in the vicinity of New York was taken by outsiders for its presence in the city itself. Still it may well have been present in spots not visited by Mr. Mead, and I myself found it swarming about parks in the heart of the city in June, 1870. I can find no record of its appearance this year in Long Island. In 1869, then, with the exception of a straggler toward Philadelphia, the butterfly is not known to have spread more than ten or fifteen miles in any direction from New York.

The northern horde of invaders in the meantime was steadily pushing southward; how far to the west is quite unknown, for there are no reports for 1869 from the St. Lawrence valley, except the one above referred to, of its ravages at Chateauguay. So too from Vermont and New Hampshire, the only accounts are of its great abundance in the northern portions and its appearance in every quarter there, including the alpine regions of the White Mountains. In Maine, moreover, it had everywhere reached the seacoast and was found in numbers in all the inhabited portions. It was abundant at Bangor (Chase, Riley) and reported from Norway (Smith), Mt. Desert Island, end of July (B. P. Mann), Eastport (Smith), and Portland (Dimmock). It was indeed along the seacoast that it pushed its way southward most rapidly, for in the spring of this year it reached Boston. I saw my first specimen on July 17, on Boston Common, but other observers were ahead of me. Mr. P. S. Sprague, for instance, saw it in the same spot April 26, and Mr. F. A. Clapp on May 20; by the autumn they were not very uncommon. A single specimen was also said to have been seen this year near Worcester, according to a paper read by Mr. W. Dickinson before the Natural history association of that city (Worcester Spy, March 16, 1870), but this is rendered exceedingly doubtful by subsequent reports. Probably the nearest point at which the northern horde approached the southern was somewhere on the Hudson or Connecticut rivers not far above the latitude of 43° N.

For although, as we have seen, it was abundant at Sudbury in August, 1868, it was not until the spring of 1870, to which year we now turn with some curiosity, that it was recognized in the centre of Eastern New York, where two such entomologists **1870.** lived as Dr. Asa Fitch and Mr. J. A. Lintner. East Greenwich, where Dr. Fitch resided, is almost halfway from Albany, Mr. Lintner's home, to Sudbury, Vt., yet in both these New York localities it appeared for the first recognized time in 1870, and then not until midsummer. Under date of March 16, 1872, Mr. J. A. Lintner writes me in detail regarding its appearance this year: "I observed it here [Albany] for the first time on July 24. Dr. Fitch reports it at his residence in East Greenwich, Washington Co., thirty-two miles in a direct line E. of N. from Albany, on the 2d of August. On August 6, I saw it quite numerous at Saratoga Springs, thirty miles north, and on the 8th at Glen, Warren Co., sixty-five miles W. of N. of Albany. During the month of July a large number of the butterflies were seen at Crown Point and Westport on Lake Champlain, and at the latter place [a short distance northwest of Sudbury, Vt.] the garden cabbages were so utterly ruined by the larvae that they were pulled up and fed to cattle . . . Sept. 11, I observed it abundantly at Utica, Oneida Co., ninety-five miles west by rail. Oct. 8, I saw larvae but no butterflies at Cherry Valley, Otsego Co., fifty miles westerly. The latter part of July it was seen at Sharon Springs, forty-five miles west; while at Schoharie, an intermediate point thirty miles west, I did not detect it until perhaps two weeks later." As it is not reported from the eastern end of Lake Ontario for a year or two, the butterfly probably reached Utica by the eastern rather than the western side of the Adirondack region and thus have spread more rapidly in a western than in a southern direction from the southern end of Lake Champlain. Moreover, Mr. H. B. Hawkins tells me, on the authority of Mr. W. E. Yager, editor of the *Oneonta Herald*, that it appeared this same year in Oneonta, Otsego Co., considerably to the south and east of Utica. Along the Hudson, Mr. Lintner does not report it as extending farther south than Bath (Ent. Contr. II, 54) five miles below Albany in September. There can be no doubt that it had this year completely overrun Vermont and New Hampshire, though the only records I have in the southern portions are that the first specimens were taken by Mr. C. P. Whitney at Milford, N. H., on May 26 of this year, that it was abundant there by autumn, and taken in numbers at Walpole, N. H., in June (S. I. Smith). But it had followed down the Connecticut valley much farther than this, for it was taken at Holyoke, Mass., by Mr. J. E. Chase; and Dr. George Dimmock reports (N. E. Homestead III, No. 46, Mar. 25, 1871) that the first specimen was taken near Springfield in the early part of May on the Longmeadow road; that it was abundant before autumn and that in July he took it in considerable numbers as far south as New Britain, Conn. The first noticed by Mr. E. Norton at Farmington, Conn., were also seen this year but "not often"; in the following year it was quite common. It also became common this year at Walpole, Mass., seventeen miles southwest of Boston (Miss C. Guild). It would appear therefore that, at the close of 1870, the southern limits of the northern host were at about the parallel of 42°, 10'-30' with a considerable extension down the Connecticut valley.

Meanwhile the southern horde was extending its outposts. The entire extent of Long Island was occupied this year, for Prof. S. I. Smith found the butterfly very common at Fire Island Beach in August and Mr. B. H. Foster reports destruction at Babylon (Am.

Ent. II, 341). In further direction toward the northern band, Mr. Dimmock found "a few" at Bridgeport, Conn., in July, which may have belonged to the other group, but far more probably were the descendants of those that occupied West Farms the year before. Dr. S. Lockwood tells me that it invaded Monmouth Co., N. Jersey, in 1870 and in October of this same year the editor of the American Entomologist saw it around fruit stands in Philadelphia (Am. Ent. II, 338); Mr. W. D. Doan writes me that it appeared in scanty numbers this year at Atglen, Chester Co., Penn., and Mr. Townend Glover in one of his Government Reports says that it appeared even as far as Baltimore "anterior to 1870"; but this I think must be an error of memory. It appears then that the southern horde did not this year quite reach the northern, but the two approached each other so nearly as inevitably to mingle in 1871; that the northern had almost everywhere reached the eastern seashore of New England and the Canadian provinces, and on the west had extended probably to Lake Ontario and nearly to central New York. The southern, on the other hand, had covered Long Island eastwardly, and was pushing its way also along the northern shore of the Sound, while its main army was directed southward, had covered New Jersey, and extended into eastern Pennsylvania.

In the next year, 1871, these two armies, having devastated the country with independent forces for fully three years, met and mingled, and then swept westward and southward with increasing rapidity. They covered all the ground which lay between the outposts of the previous year, this being the year in which it was first seen in Rhode Island, at Providence (H. L. Clark), and at Hunter, N. Y. (W. H. Edwards). It also extended to some of the higher regions previously untouched but swept past, such as Williamstown, Mass. ("in force" S. Tenney), and became as usual excessively common where it had only appeared scantily the year before. There were even some spots not invaded until 1872, and it would appear that the advance guard, which swept down the rivers flowing southerly and along the seacoast, left the inland districts long untouched. Thus it is reported as not seen in Stowe, Mass., at the close of 1871 (C. A. Emery). Mr. Dickinson showed to the Natural history association of Worcester in 1872 several specimens that had been found in a garden there, as if they were of special interest as new comers (so that the rumor that one was taken there in 1869, *supra*, must be an error), and it is thought not to have appeared in Sherborn until 1872 (A. L. Babcock). By that time it had probably overrun every nook and corner of New England. Similar irregularities appear in all its subsequent movements westward.

Of its westward movement in 1871, we still have no information from northern New York or north of the boundary, and can only judge by subsequent notices that it must have reached at least the extreme eastern end of Lake Ontario. It had certainly passed the centre of New York, being found common at Ithaca this year (J. H. Comstock, L. O. Howard), where indeed it made its first appearance the preceding year according to Mr. Howard, though Mr. A. C. Weeks thinks it did not occur in Tompkins Co. in 1870. It was "troublesome" this year or 1872 at Cazenovia (L. M. Underwood), while Mr. Saunders states in his address to the Entomological society of Ontario (Rep. 1877, 5) that "by 1871 it had travelled . . . west to the middle of the state of New York". In Pennsylvania it is reported as harmful this year in Luzerne Co. (T. Glover), and as present at Easton (Mrs. J. P. Ballard) and Lancaster (S. S. Rathvon); this does not greatly increase its westward range. But it had pushed somewhat farther southward,

following the coast line; injury was done to crops in Cecil Co., Md., during this year, according to the reports of the Agricultural Department (Glover), and it appeared in Baltimore according to C. R. Dodge (Rural Carol., August, 1872). Writing me from Spottsville, Va., Mr. B. W. Jones says, "It was a general complaint (in Surry Co.) as early as 1870-71 among farmers, that they could raise no good cabbage on account of it. In 1872-73 it infested the gardens about Petersburg in untold numbers." Yet it was not seen in Washington until 1872. This year then is remarkable for the union of the two armies and the considerable westward extension in New York.

In 1872 we again are able to trace the forward movement of the butterfly in Canada, where it originated, and from which information entirely fails from 1867, when it reached

Montreal, until this time. For now we learn that it had passed by this time along 1872. the northern shore of the St. Lawrence and Lake Ontario to Belleville and Trenton, Ontario (Bethune, Can. Ent. v, 41). But south of the river and the lake it had pushed much farther, viz., through the entire length of the state of New York, so as to invade Canada from the United States! It did not reach Port Hope, Ontario, from the east, where Mr. Bethune was awaiting it ("we fully expect to see it at Port Hope this year,"—Can. Ent. v, 41,) until July 1873, but it appeared at Ridgeway, Welland Co., "not in great numbers" in 1872 (A. H. Kilman), and at Toronto in August, 1872 (W. Brodie—*cf.* Canada Farm., 1875, 127). This makes it highly probable that it reached Buffalo this year, of which I could not otherwise speak, as the testimony of my correspondents is widely conflicting. Certainly it reached Brockport, for it was taken there in September by Mr. David Bruce, and the next year had certainly spread much farther west on the southern than on the northern shores of Lake Erie. It was in this year that it reached Delhi (L. O. Howard). In Pennsylvania, though it probably reached Centre Co. in this year (W. A. Buckhart), it was possibly checked in its westward spread by the Alleghanies, as we do not hear of it in the western part of the state. It reached Washington early in this year (Monthly Rep. Dept. Agric., June 1872, 218) but how much farther south it passed we do not know. As however we have already heard of it in Virginia it is probable that it had extended southward at something like its previous rate and we have accordingly drawn our curve, to correspond with this.

In 1873, as before stated, it reached Port Hope, and "F. C. L." reports taking his first specimen at Dunn in Haldimand Co., Ont. (Can. Ent. 6, 60), and some were taken at

1873. Hamilton (J. A. Moffat), where one would have looked for it the preceding year from its presence then at Toronto. This year it had entirely covered New York state, though there were places even in the eastern half, such as Norwich, where it did not appear until this year, at least in any number (J. S. Kingsley). It was found sparingly at Cleveland in the spring of this year¹ (J. G. Gehring), but from here southward our information is practically a blank. We have, however, two curious items: it is reported by Mr. C. R. Dodge as being destroyed by parasites in Louisville, Ky., in this year, which implies that it appeared there at least the year before (probably Mr. Dodge's informant mistook the destructive southern cabbage butterfly for this).

The other is a very definite piece of information from Prof. J. R. Gibbes of Charleston,

¹This is the first definite statement of its advent in Ohio, but Mr. W. H. Edwards, in Part 8 of his Butterflies of North America, says "It swarms [August, 1871] in many parts

of New York and New Jersey and in Ohio." The last is clearly an error.

who, in a recent letter to me, after mentioning the year 1870 as one which was remarkable for the number of Lepidoptera seen in that city, says that *P. rapae* (of which he possessed English examples in his cabinet) was not to be found, but "in 1873 I observed it as not uncommon in this city, and recognized it at once, while flying, as distinct from its congeners *P. monuste* and *P. protodice* . . . I have seen it I think every year since." This appears to be an unquestionable independent introduction of the species from a coasting vessel, and it is due to this probably that we find it invading the southern Atlantic states sooner than we should otherwise anticipate. In the curves, therefore, I have given this new southern horde a distinct claim to local independence, and brought the northern curve to the ocean at a comparatively high latitude.

In 1874 we again hear of the insect to the east of its point of origin, N. Corneau reporting it as rare at Godbout river on the lower St. Lawrence, the northeasternmost point from which it has yet been recorded (Can. Ent. vii, 208); its progress westward in Canada seems to have been very slow. It was abundant now at Hamilton but it did not reach Paris this year or certainly not until the very end of the year. It had become noticeable at Cleveland by its ravages during this summer¹ as well as in western Pennsylvania (T. B. Comstock, Am. Nat. ix, 426). It made its appearance among the mountain valleys of West Virginia in September, where it became abundant the following spring (W. H. Edwards, Pap. i, 96). It was "by no means rare" in Virginia (Bethune, *loc. mult.*)

Of the extension of the southern horde we know nothing, but from the record of later dates I have assumed an enlarged curve which seems best to agree with the facts.

But here enters a new factor. Dr. A. W. Chapman, a well-known and experienced lepidopterist, in response to my circular, writes to me from Apalachicola, Florida, that the butterfly first appeared there in 1873 or 1874; adding that it has not yet become common, only half a dozen being seen in a season. Here we have a second southern coastal introduction, unless indeed it was imported from Charleston by rail direct, as seems more probable. Its appearance, however it came about, at these two southern stations at such an early period explains why, when the insect does not flourish so well in the extreme south as farther north,² it managed to reach Alabama at least as soon as it obtained a foothold beyond the Mississippi.

Turning now to the year 1875 and beginning as before at the north, we find that according to Mr. Saunders it reached Paris, Ont., in the spring of 1875, and London in August (Report Ent. Soc. Ont. 1875, 31; Can. Ent. vii, 163). The same good authority tells us (*ibid.*) that it had reached western Ohio, and a gardener in southwestern Ohio reports that it first troubled him in 1876 at Mt. Repose, Clermont Co., and therefore presumably reached that place by 1875 (F. G. Fisher). It did not however reach Cincinnati until the following year (C. Dury) though it had followed the western Alleghanies down to Maryville, Blount Co., eastern Tennessee, a little south of Knoxville, where Mr. E. M. Aaron saw it in 1875. It was now common in West Virginia, and presumably extended into North Carolina, though we have no report from

¹ Dr. J. F. Isom reported that it first appeared at Cleveland in the spring of 1875 (Can. Ent. vii, 180); but he is certainly in error.

² In evidence of this, the fact that it is still scarce at Apalachicola is supported by its failure to invade the peninsula of Florida.

there until 1878, when Mr. W. V. Andrews found it in March at Asheville. The southern part of our line for this year is, therefore, purely conjectural, as are also the lines for the southern colonies, from which we have no data.

There enters now a good deal of confusion in the dates of its appearance as obtained by correspondence in different parts of the west. The insect had become abundant on all the main railway lines running east and west and was liable to be forcibly carried in any direction. Wherever a pair, male and female, happened after all vicissitudes to come together, there would be the point for the introduction of a new colony; for mignonette or cabbage or turnip would be found somewhere about; and the only wonder is that the movement of the throng was as regular as it was.

During 1876 it covered the whole of western Ontario (Saunders *loc. cit.*) and extended into eastern Michigan (A. J. Cook); Mr. E. A. Strong even states that he took it at

Grand Rapids in 1875, but this I think must be a fault of recollection. Below

1876. the Lakes however, it moved on more rapidly. It is possible, if not probable, that one of the roadside colonies to which I alluded above was established in central Indiana before this, for Mr. S. G. Evans says that *Pieris rapae* was common in Evansville when he commenced collecting there in 1874; and Dr. G. M. Levette writes me from Indianapolis, "From recollections of myself and others I would place it [the introduction of *P. rapae* at that point] in 1872 or 1873." We have the very definite statement from Dr. F. W. Goding that he captured a female in his father's garden in Kane Co., Ill., 44 miles west of Chicago on Sept. 17, 1875. A few days afterward he saw several, as he now distinctly remembers, in cabbage fields west of Chicago, flying in company with *P. protodice*. Mr. J. W. Huett also writes that he first saw the butterfly at Farm Ridge, LaSalle Co., in the spring of 1874 or 1875, in scanty numbers. It would therefore appear highly probable that, a year or two in advance of the normal rate of progress, *Pieris rapae* swept into Chicago on a railway train. We have no further record for this year of the advance of the great horde, but simply from analogy and subsequent facts, the curve of its probable progress has been placed on the map.

In 1876, however, we have indications of the spread of both of the southern colonies, for in October of this year, Dr. A. Oemler detected the butterfly at Wilmington Island off Savannah,—evidently an extension of the Charleston colony of 1873; while the fact that the butterfly was as common in 1876 as now at Lumpkin in the southwestern part of the state, as I am informed by Mr. A. W. Latimer, indicates the spread of the Apalachicola colony.

In 1877, to begin now with the south, these two southern colonies probably merged, for the butterfly was common at Macon, as reported by Prof. J. E. Willet at the August

1877. meeting of the Georgia Horticultural Society, a point which probably might have been reached by either colony this year, though not by the northern horde for a year or two later, to judge by all accounts. For, to forestall the succeeding years a little, the pest was not noticed in northern Alabama until 1879, nor at Atlanta, Georgia, until 1880, nor at Chester, S. C., until 1881 (L. M. Loomis).

From these points to Illinois is a long leap, but for this year it has no record. Excepting for the notice of its common occurrence at the head of Lake Rosseau in the Muskoka District, east of Georgian Bay, Canada (Saunders, Can. Ent. ix, 185), the only

remaining data are for Illinois and Michigan; the butterfly had covered the lower half of the lower peninsula of Michigan (A. J. Cook, E. W. Allis) and part of Illinois. The specific points which it had reached in the latter state are the region about Chicago, — Maplewood (C. Thomas, G. H. French), DeKalb Co., sixty miles west of Chicago (F. M. Webster), — Decatur (W. Barnes), and Champaign, in the autumn (C. Woodworth). The first two of these may easily have been the mere extension of the Chicago colony, the latter two of the Indiana, but, in all probability, the succeeding year saw a blending of all the colonies both north and south.

For then, 1878, not only is almost the whole of Illinois invaded, but the advance guard has pushed across the Mississippi and intrenched itself in Iowa and Missouri. According to Dr. C. Thomas, it appeared at Carbondale early in the year and "in injurious numbers" at Springfield (9th Rep. Inj. Ins. Ill., 9). It had crossed the Mississippi at at least two points. Prof. R. R. Rowley writes me from Curryville, Pike Co., Mo., that he collected two specimens on radish blossoms at Louisiana in that county in July, 1878, and Prof. S. M. Tracy says that he noticed it at Columbia, in 1877, the first year of his residence there¹. Further, Mr. J. M. Myers writes me that five or six specimens were taken at Fort Madison, Iowa, in the autumn of 1878; and the same fact is reported by Mr. A. W. Hoffmeister (Trans. Iowa Hort. Society, 1879). There can therefore be little doubt that it was in this year that it first crossed the Mississippi. In Tennessee too, it was close to the Mississippi in 1878, for according to Mr. F. P. Hynds it appeared this year at Ralston Station in Weakley Co.; and it was in March recorded from Asheville, N. C., by Mr. W. V. Andrews (Can. Ent., x, 98).

In 1879 it had extended up the peninsula of Michigan, having been taken at Ludington either this year or the preceding by Mr. N. B. Pierce, and had invaded Wisconsin, appearing in May about Racine (P. R. Hoy) and being abundant there (O. S. Westcott) although it did not reach Milwaukee that year (R. T. Church). Dr. Hoy's printed statement will be found in his list of Wisconsin Lepidoptera, and should be noticed by any one led astray by the statement in the American Entomologist (11, 79) that it was said by Dr. Hoy to be tolerably common in Wisconsin in 1869. This last publication may account for the statement by Dr. Fitch in his thirteenth Report on New York insects, in speaking of the new cabbage pests, that "the present year (1870), probably favored by the protracted drought, they have suddenly overspread a large portion of the middle and *western* states," when in fact they had not extended westward beyond the middle of his own state. Possibly it was based on the statement already referred to in Edwards' Butterflies. Mr. Riley has also stated (U. S. Agric. Rep., 1883, 109) that it had appeared in Green Bay (Wisconsin) in 1874, but that probably his correspondent mistook an allied species for it. In Iowa it made rapid advances. We have already seen it at Fort Madison in the southeastern corner. It probably appeared in 1878 also at Keota in Keokuk Co., for it was destructive there before the end of 1879 (A. S. Van Winkle). At Muscatine, according to Miss Alice Walton, now Mrs. Beatty, it appeared in the latter part of May (Proc. Musc. Acad., Nov. 3, 1879) and according to Mr. F. M. Witter (Proc. Iowa Acad., 1875-80, 21-22) became destructive that year. It appeared this year also in Linn Co., where it was very destructive (Riley). But it went beyond

¹ This is certainly possible, but it was more probably in 1878, to judge by other reports.

the eastern tier of counties, for it was found at Des Moines, according to a correspondent of the *Prairie Farmer* of Chicago (*Am. Ent.*, III, 55), and in the autumn it reached Ames (H. Osborn), and had even advanced by midsummer to Omaha in Nebraska, according to Mr. L. Bruner, *i. e.*, across the entire state of Iowa. In all probability it may have been prematurely carried to that great railway centre by the freight trains. The surprising thing about this is that it appeared to have no outcome, as we shall see. The butterfly appeared also about St. Louis this year (Miss M. E. Murtfeldt) and at many localities in Alabama, such as Marion (J. F. Bailey, *Am. Ent.*, III, 107) and Selma (Riley), though Mr. Riley did not see it at Mobile on a visit there (*U. S. Agric. Rep.*, 1883, 109).

In 1880 it had advanced in the north, according to Mr. Saunders, to Manitoulin Isl. and near the northeastern end of Lake Huron (*Can. Ent.*, XII, 192-195), to the Sault Ste. Marie, to Rochester in the southeastern corner of Minnesota (C. N. Ainslee), 1880. to West Point, Nebraska (L. Bruner), to Lawrence, Kansas, in March (F. H. Snow) and to Manhattan in the same state (W. Knaus, E. A. Popenoe). Dr. W. S. Newlon writes me that, according to his note book, it appeared at Oswego in the southeastern corner of the state on June 10, 1879, but he is not quite positive about the year. It is also reported this year from Atlanta, Ga., in July, by C. V. Riley (*Am. Ent.*, III, 200). It must have been there the year previous.

In 1881 we have few reports of its extension, but it was this year that it became common on Keeweenaw Point, at Calumet, Mich. (E. T. Custis), though the postmaster at Kasson, Leelenaw Co., told Mr. E. W. Allis that it did not appear 1881. in that place until a year or two later. It was as late as Aug. 3 that Mr. G. M. Dodge first saw it at Glencoe, Dodge Co., Nebraska, not fifty miles from Omaha (*Can. Ent.*, XIV, 39) and not until this year did it make its appearance at Salina, Kan., becoming common in 1882 (A. W. Jones). It is also reported as appearing in 1881 at Bastrop, Texas (L. Heilegerodt).¹

In 1883 (there being no statistics obtainable for 1882) we have several very interesting extensions. Mr. Walter Hayden, returning to England in 1883 from Moose Factory at the extreme southern end of Hudson Bay, took with him an interesting 1883. collection of insects, among which Mr. J. Jenner Weir found a single pair of *P. rapae*, which were all he had taken there in a residence of five and a half years. Presumably the insect had arrived shortly before his departure. It was only in this year, according to Mrs. E. A. Patten, that it appeared at Minneapolis, Minn., yet it was now that Capt. Gamble Geddes took it in Manitoba along the line of the Canadian Pacific Railway, at least as far as Brandon, about longitude 100°. Further, Mr. Charles S. Brown of Ludden, Dickey Co., Dakota, writes me that he reached that country in 1883—one of the first settlers there—and noticed then a few specimens of the butterfly, which has since become common. It is evident that it has nearly outrun the tide of civilization.

But even this record is outstripped by the report that it actually reached the Rocky mountains in Montana in 1884. Two correspondents have answered my inquiries from

¹ Mr. N. Coleman found it in Marshall, Texas, when he moved there in 1884. He thought it had not been there long.

there; one has not seen it and says it must be rare or local if there at all; the other has occasionally noticed a *Pieris*, but took it to be *P. oleracea* (R. S. Williams); the other, Mr. F. W. Anderson, says he saw none in 1883, one in 1884 and another in 1886. North of the boundary, according to the report of a four years' resident, the insect has not yet reached Regina (N. H. Cowdry). 1884.

A few words only will suffice for all later statistics. In 1885 it is recorded from Duluth, at the western end of Lake Superior (W. H. Edwards); and Mr. David Bruce, who has spent the last three summers in Colorado and has closely watched all white butterflies on the search for some of the rarer forms, met with *P. rapae* for the first time in 1886, seeing a dozen specimens about Denver between August and October. In this same year it apparently made its first advent into the eastern half of Florida. Enquiries, last autumn, of several entomologists residing there, Messrs. Ashmead at Jacksonville, Hubbard at Crescent City, Mead and Chase in Orange Co., elicited the uniform response that the butterfly had not reached there; but Dr. J. M. Wheaton of Columbus, Ohio, writes me that he obtained a single battered specimen about the first of April, 1886, while on a visit to Jacksonville. There is probably, therefore, no state in the Union, east of the Rocky Mountains, where it does not occur, though it has not been reported, to my knowledge, from Mississippi, Louisiana or Arkansas. It is hardly possible that it has not covered nearly or quite the whole of each, though Mr. R. d'Ailly of Malvern, Arkansas, writes me that it has not yet reached that place in the centre of the state. 1885-6.

If now we examine the map upon which these statements have been represented, we shall be struck, I think, by two or three principal points: 1. The more rapid spread of the butterfly, at first, toward the east and southeast until it reached the sea, rather than toward the southwest along the valley of the St. Lawrence. 2. The comparatively small amount of hindrance mountainous and elevated countries seem to have presented in the early part of its career; indeed, if the first record of its appearance in East Tennessee is correct (and we have excellent authority for it) these would seem in the warmer latitudes to have offered a distinct highway for the movements of the army, which the curves for 1874-1877 are meant to show. 3. The favorable influence of colonies on the spread of the pest with the single exception of that at Omaha. 4. The excessively rapid, forward movement toward the west and southwest as soon as the Valley of the Mississippi is reached; compare, for instance, the five years' advance from Cincinnati, Ohio, to Lawrence, Kansas, or to Bastrop, Texas, and the otherwise rapid five years from central New York to western Ohio, or the five years it took to cover the New England states. 5. The natural limit to its southern extension, as shown by the fact that it can hardly maintain itself at Apalachicola and has not pushed its way into the peninsula of Florida beyond, hardly to, Jacksonville, although it has for ten years been within what would elsewhere be not more than a year's flight away.

It may here be mentioned, as a fact noted by every one who has studied butterflies and by many others, that as fast and as far as *Pieris rapae* has spread, it has almost exterminated the native white butterflies, both the southern cabbage butterfly, *Pontia protodice*, which is itself harmful, and *Pieris oleracea*, which is comparatively innocuous. It is also observed that the second year after the advent of *P. rapae* is the one in which

it is most numerous and does the most damage. Its parasites then follow it up and its injuries, though still serious, are by no means so alarming.

I have purposely refrained from mentioning hitherto the fact that, in the opinion of some entomologists, *Pieris rapae* is indigenous to the Pacific coast of America, or at least has been known there for fully a quarter of a century and no one knows how much longer. Specimens were first brought east by Mr. A. Agassiz in 1859. It is well known that the butterflies (not to mention other animals) of the Pacific coast are more nearly allied to those of the Old World than are the butterflies east of the Rocky Mts.; and therefore, to one regarding these western Pierids as identical with *P. rapae*, they may well be looked upon as autochthonous, inasmuch as in the Old World *P. rapae* extends from the Atlantic to the Pacific, from Great Britain and Barbary to Kamtschatka and Japan. In his elaborate paper on the American forms of *Pieris* allied to *P. napi* of Europe (Papilio I, 83-99, pl. 2-3), Mr. W. H. Edwards has argued that all the American species of *Pieris* (as I have limited it) which do not belong to the European *P. rapae*, are to be classed with the European *P. napi*, and in his last catalogue he has so arranged them, excepting that for some unaccountable reason he separates as a distinct species *P. virginensis*, which he himself stated three years earlier had given birth in Mr. Mead's breeding experiments to the form *oleracea*.

This is not the place for the discussion of affinities, so I can only here express my present dissent from the conclusions of Mr. Edwards, mainly upon the very grounds set forth in his paper, in which I think he has confounded two distinct species. My own belief is that we have in America, in addition to the introduced *P. rapae*, two distinct autochthonous species, each of which shows seasonal dimorphism similar to that of *P. rapae*, and at least one of them some marked geographical races. One species, generally known as *P. oleracea*, covers the continent from ocean to ocean and reaches from Alaska and Labrador to Central California, Colorado and Virginia. It has been described under many different names, such as *casta*, *cruciferarum*, *marginalis*, *frigida*, *hulda*, and *virginensis*, besides several varietal designations. As a general rule it has no spots upon the upper surface, though these sometimes appear, probably by reversion. The other species, *P. venosa*, has been hardly less tormented with appellations, having been also christened *pallida*, *yreka*, *castoria*, *nasturtii*, *resedae* and *iberidis*. It is found along the Pacific coast from central California to British Columbia at least as far as Lat. 52° N. It is closely allied to and may be said to represent *P. napi* in this country. It is, however, as distinct from *P. napi* as *P. napi* is from *P. rapae*, and the only logical outcome from the position assumed by Mr. Edwards is, in my opinion, to consider all these species of *Pieris*,—*rapae*, *napi*, *oleracea* and *venosa*, as different forms of one species. It matters little whether they are looked at in this light or as distinct species, for they undoubtedly came from the same stock. The only claim I would make is that if *P. rapae* and *P. napi* are distinct species, as they are universally considered in Europe, then the American species, previous to the introduction of *P. rapae* into eastern Canada, were distinct from the European and from each other. That certain forms of each of them, and especially of *P. venosa*, might readily be taken (as has been done) for *P. rapae* is unquestionable, and it is possible that the species, seen in 1884 and again in 1886 at Great Falls and the Belt Mts., Montana, was *P. venosa*, so marked. I have accordingly cov-

ered the area upon the map over which *P. venosa* is known to extend with close cross ruling, and that which it may probably also occupy with more open ruling. It will thereby be seen that the introduced *P. rapae* is rapidly progressing toward its near of kin. It may well be believed that if *P. rapae* has in the last five years crossed the high plains of Kansas and Nebraska on its westward march, as it has done, the butterfly considered by Mr. W. H. Edwards and others as *Pieris rapae*, which has been on the Pacific coast since 1859, would, in more than a quarter of a century, if it were *P. rapae*, certainly have extended eastward across the less arid country along the northern boundary of the United States to a proportionably longer distance,—which it certainly has not done. It therefore fails in one characteristic of that ravenous and destructive species. It should be added that the only forms considered by any one as identical with *P. rapae* are those described by myself as *P. marginalis* and by Mr. Reakirt as *P. greka*. They came from California, Oregon and Washington Territory.

With regard to the nature of the documentary evidence a few words may be said. One would expect that much might be learned from agricultural and horticultural journals about the movements of the butterfly, but a great amount of time has here been wasted in vain search; very little was to be found and that little generally so vaguely stated as to be valueless. Direct enquiry has been almost the sole resource of value after the entomological journals, and especially the pages of the Canadian Entomologist.

In the mass of information received from very various quarters in reply to my circular of inquiry, it has of course been impossible to weigh the evidence for exactly what it was worth. Some of it, as was to be expected, had to be thrown out altogether as coming from those who were not sufficiently observant to have distinguished between the new pest and its allies, also destructive to cabbages. To adopt indiscriminately all the data offered would lead to a chaotic result: we should be obliged for instance to say that the butterfly appeared in Ohio in 1865, when it had only that year crossed the northern border of New England; or that it reached central Illinois in 1871 or 1872, or even in 1859 when it had not yet been borne across the ocean; or that it appeared in Georgia in 1862 and was abundant there in 1866, some ten years before its time. More possibly correct is the nearly accordant testimony of no less than three reporters, whose judgment I have no means of testing; they agree in giving 1864 or 1865 as the date of the first appearance of the butterfly in eastern Pennsylvania and a fourth refers to it hesitatingly, perhaps as a matter of report; it is possible that it might have been brought across the ocean direct to Philadelphia at that date, but as it did not attract the attention of other entomologists in and about Philadelphia or make its impression on the country around, the supposition is rendered highly improbable; nor do the facts given above regarding its spread about New York lead us to admit that it reached that city from Philadelphia. It is far easier to suppose either that a mistake was made by each observer in the species concerned, or that the memory was at fault,—all these statements coming to me in answer to my enquiries last autumn; none of them are printed records. The point may perhaps be best solved by entomologists of that region, if they wish to follow it up; in which case the details in my possession will be furnished to any competent person.

I have not mentioned above a report made to me by an entomologist, Mr. George Bowles, whose specialty is Coleoptera, who states that when on a natural history expe-

dition to the West Indies and South America, he passed two days at the Island of Dominica, and there "observed the butterfly [*P. rapae*] along the edges of the canefields and in many parts of the town (Roseau), and I was told, it lived upon the mustard plant." This is an extract from his journal of February 23, 1884. In a subsequent letter he states that he is quite confident of his identification of the butterfly as it was very numerous and he had "paid particular attention to it in this country" from his interest in it through his cousin Mr. G. J. Bowles, who first brought it to notice in the Canadian Naturalist. Unfortunately all his collections, possibly including specimens of the butterfly seen, were lost by an accident on the Magazine River, British Guiana. Mr. Bowles gave me the addresses of persons in the Antilles who, he thought, might obtain specimens for me, and I have received replies from them, but as yet no autoptic evidence that *P. rapae* exists there, nor indeed anything to corroborate Mr. Bowles' belief, excepting from one gentleman who writes: "I have an idea I have seen the butterfly you mention, but am not certain." Enquiries are not yet closed, however.

In conclusion, it may be remarked that the definite setting down of territorial limits to each year's spread will naturally raise the question in the mind of every lepidopterist who examines the map, whether it rightly interprets the matter for the ground with which he is familiar. I beg therefore to ask those who see reason to question the accuracy of the lines at any point kindly to give me the benefit of their better knowledge, by exact and detailed statements; and, where possible, founded on something better than memory. Should a sufficient number of important divergences come to light, I will make them public in a formal statement. It may be stated, in a general way, that the lines are more conjectural in the southern states than elsewhere, owing to the paucity of observations.

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